Citation:

Mendez MA, Covas MI, Marrugat J, Vila J, Schröder H. Glycemic load, glycemic index and body mass index in Spanish adults. *Am J Clin Nutr*. 2009 Jan; 89 (1): 316-322.

PubMed ID: 19056597

Study Design:

Cross-Sectional Study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine associations between body mass index (BMI) and glycemic load or glycemic index in a Mediterranean population, accounting for underreporting. To understand dietary factors related to glycemic load and glycemic index.

Inclusion Criteria:

- Aged 35-74 years old
- Free living adults in Girona, Spain.

Exclusion Criteria:

- Extreme BMI values (>60 or <18.5kg/m^2)
- Extreme energy intakes (<800 or >4,500kcal).

Description of Study Protocol:

Recruitment

Details of survey strategies were not specified.

Design

Retrospective analysis of cross-sectional data gathered by surveys conducted among free-living adults in Girona, Spain in 2000 and 2005.

Dietary Intake/Dietary Assessment Methodology

Validated food-frequency questionnaires (FFQ) administered by a trained interviewer were used to collect dietary intake information. Usual intake information was determined from a

self-administered FFQ.

Blinding Used

Not applicable.

Intervention

Not applicable.

Statistical Analysis

- Reduced-rank regression was used to determine associations between dietary patterns associated with dietary glycemic load or glycemic index
- Comparisons of means or proportions were used to determine population characteristics associated with dietary glycemic quality
- Linear or logistic regression was used to assess age-adjusted trends across tertiles of glycemic index or load
- Linear regression models were run seperately to determine associations between BMI and glycemic load, glycemic load dietary factor, glycemic index and glycemic index dietary factor
- Analysis of men and women was conducted separately
- Analyses for associations with tertiles of glycemic load or index were stratified with regard to underreporting
- Interactions between physical activity and carbohydrate quality, and the impact of diabetes/glucose intolerance were tested in secondary analyses.

Data Collection Summary:

Timing of Measurements

All data were collected at a single time point within each survey.

Dependent Variables

BMI: Determined from anthropometric data collected by trained nurses.

Independent Variables

- Glycemic load (GL): Dietary GL was calculated by multiplying the daily GI by the amount of carbohydrate consumed and dividing the product by 100 [(daily GI x grams carbohydrate consumed per day) /100]
- Glycemic index (GI): Estimated by using average values from Foster-Powell et al (15), with glucose as the reference food; average daily dietary GI was calculated by multiplying the GI of individual foods by the percentage of total energy contributed by carbohydrate (Sum of [GI food item x (grams carbohydrate per serving food item x servings consumed per day/grams carbohydrate consumed per day)).

Control Variables

- Dietary intake including fiber, alcohol intake, energy intake: Estimated from FFQ information
- Demographic (age, sex) and socioeconomic variables (including education level), medical

history, lifestyle (including smoking history), physical activity: Collected from standard surveys administered by study staff
- Energy intake:
    - Basal metabolic rate ratio:
        - Estimated from equations for basal metabolic rate using age, sex, body weight and height. Ratios of <1.20 were classified as under reporters.

Description of Actual Data Sample:

- *Initial N:* 8,195
- *Attrition (final N):* 7,670 after exclusion of subjects with extreme BMI or energy intake (3,669 men, 4001 women)
- *Age:* 35-74 years
- *Ethnicity:* No specified
- *Other relevant demographics:*
- *Anthropometrics:*
    - Tertile of dietary glycemic index was significantly (P<0.05) associated with age, smoking, alcohol consumption, underreporting, leisure-time physical activity (women only), total energy intake, carbohydrate intake (men only), protein intake, fat intake (women only) and fiber intakes. Tertile of dietary glycemic index was not significantly (NS) associated with primary education level
    - Tertile of dietary glycemic load was significantly (P<0.05) associated with age, smoking (women only), primary education level (women only), underreporting, leisure-time physical activity, total energy intake, carbohydrate intake, protein intake, fat intake and fiber intakes. Tertile of dietary glycemic load was NS associated with alcohol consumption
- *Location:* Northern Mediterranean coast of Spain.

Summary of Results:

- Factor loading analysis indicated that the following foods had the largest contribution to glycemic index dietary scores: Refined bread (positive; women and men); fruit (negative; women and men); low fat dairy and yogurt (negative; women); high fat dairy and yogurt (negative; men)
- Factor loading analysis indicated that the following foods had the largest contribution to glycemic load dietary scores: Refined bread (positive; women and men); pastries (positive; women and men); fruit (positive; women and men)
- Multivariate linear regression adjusted for age, leisure-time physical activity, educational level, smoking, alcohol consumption, dietary fiber, underreporting, and energy intakes did not find a significant association between tertile of dietary GI and BMI for both men and women
- Multivariate linear regression adjusted for age, leisure-time physical activity, educational level, smoking, alcohol consumption, dietary fiber, underreporting and energy intakes did not find a significant association between tertile of GI factor score and BMI for men. Women in the second tertile of GI factor score had lower (β coefficient= -0.48 (95% CI: -0.848, -0.112) P=0.011) BMI compared to the first tertile. There was NS difference in BMI when comparing third and first tertile in women.

Author Conclusion:

After adjusting for energy intake, glycemic load was associated with reduced BMI in this Mediterranean population. Underreporting did not explain this inverse relation, which was observed among subjects with plausible intakes.

Reviewer Comments:

- *From the methods section, the sampling strategy for the two surveys is unclear*
- *Gender distribution of overall sample is not specified. The distribution of reported extreme BMI, energy intake from original sample is not clear*
- *Information regarding ethnicity or comorbid diseases is not given*
- *The authors do not address whether participants in the first survey might also be represented in the second survey and how this might impact findings*
- *In table 2, the third tertile of dietary load in men is defined as the same mean glycemic load as the second tertile*
- *Cross-sectional data makes it difficult to assess connections between GI or GL with weight loss or gain over time.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes

2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	No
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	No
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	No
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	???
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	No
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	???

5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	???
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	???
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	N/A
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	N/A
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	N/A
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes

7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes